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An Overview of the NASA Post-Apollo Program

B. Bernier

My intention this morning is to give a broad, general overview of NASA's future plans and programs as they are reflected in our most recent budget submitted to the U.S. Congress. We feel that this is a good indicator for the future, because it reflects the transition for NASA from the Space Program of the 1960's to that of the 1970's, or the Apollo to the so-called Post-Apollo era.

Against this background, this afternoon you will hear specific talks by Drs. White, Humphreys and Saunders of NASA Headquarters on subjects in your field of interest, medicine and biology and how they are related to a space program.

In my opening remarks I hope to lay the foundation of our plans for the future, including some remarks on the possibilities of international cooperation; then I have some slides to show which will emphasize some of these points and give a visual aid for some of you who have not yet been exposed to NASA's artistic interpretation of life in space in the coming years and lastly, with the time remaining, I'll attempt to answer any questions you may have. I encourage you to take advantage of this, since the most important accomplishment I can make here today is to increase your understanding of our program and how Europe may have a part in it.

As most of you know, the past several years have seen a steady decline in the NASA budget from the mid-1960's when the peak spending for the Apollo program was passed and we had not yet formulated or adopted new goals in our space efforts. However, since last year when the President accepted the report of the Space Task Group as the basis for determining the U.S.'s future space goals, we have been debating within

NASA, within the bureau of budget management, within the congress, and with the public as to how these goals should be achieved. This debate continues but we begin to see some solid indications emerging.

We now have a fiscal year 1972 budget before congress of 3.271 billion dollars. This compares with last year's approved budget of 3.269 billion dollars, so it is obvious right away that the President and the Bureau of Budget Management think that NASA has reached a minimum level of funding. Now it remains for the congress to review and approve this new figure and this is already in progress. If we look back to last year's experience in congress with our 1971 budget, we see that it was approved twice by significant majorities (the last vote in the senate being 75 to 1 for approval) and here it must be remembered that this 1971 budget contains 80 million dollars for shuttle studies presently under way. So you see that the Post-Apollo debate in congress has already started over one year ago.

Now let us review what this 1972 budget contains, because it is the most fundamental indicator to our future plans. The best way for me to do this is to quote to you the words of Dr. Low our Acting Administrator, at a press conference this January when the 1972 budget was presented to Congress by President Nixon.

Dr. Low begins by describing first those programs that the budget permits to continue and then goes on to describe the new programs that it will permit to begin.

I quote : "These are some of our continuing programs:

"We will carry the Apollo program to completion with the four flights presently planned. But we will delay Apollo 17 by five months, to ensure that the scientific experiments that were originally to be flown on the now cancelled Apollo 18 and 19 missions will be fully prepared. This delay will also help minimize the FY 1972 funding requirements.

We will fly the Skylab Experimental Space Station mission as planned, but delay it about four months to follow as soon as practical after the last Apollo flight.

In our unmanned exploration of the planets, we have two Mars orbiters in 1971, Jupiter fly-bys in 1972 and 1973, a Venus-Mercury fly-by in 1973 and the two Viking flights with launches in 1971 and the landings on Mars in 1976.

In the Near-Earth science programs, we have orbiting Solar Observatories in 1971, 1973, 1974 and 1975 and the last Astronomy Observatory in 1972.

Our Space Applications programs will go forward as previously planned, including two earth resources technology satellites, two Nimbus Experimental Weather Satellites, two Synchronous Meteorological Satellites and two advanced communications experiments with ATS F & G.

Now let us take a look at the major new efforts:

We have included in the FY 1972 budget $100 million for the Space Shuttle. This provides for the detailed design and development of an engine - the longest lead time component for the shuttle. It also provides for proceeding on an orderly step-by-step basis with the shuttle airframe design. This may lead to continued detailed design or initiation of development of a specific design, depending on the progress of the studies now under way. In this regard, the studies are proceeding well, and we have recently settled on a single set of performance characteristics for the preliminary designs of a two-stage fully reusable shuttle. Alternate approaches to this shuttle concept are also still under study.

We also have funds in the FY 1972 budget for starting work on a new type of Space Observatory, the High Energy Astronomy Observatory (HEAO). This will be a very large unmanned spacecraft to observe celestial X-rays and Gamma-rays and high energy particles. It should help solve some of the perplexing problems of the Universe like those posed by the giant sources of energy in Radio Galaxies, Quasars and Pulsars.

We will start a program for the exploration of the mysterious outer planets : Jupiter and those that lie beyond. To do this, we will develop a versatile new spacecraft and we will plan Grand Tour missions to Jupiter, Saturn and Pluto in 1976-1977 and to Jupiter, Uranus and Neptune in 1979. As an alternate to the first of these Grand Tours, we will also study a mission to orbit Jupiter for a more detailed exploration of this nearest of the Outer Planets.

Finally, we have in the FY 1972 budget a major new initiative in Aeronautics : the development of an experimental Short-Take-Off-And Landing (STOL) Research Airplane.

During FY 1972, we will halt the downward trend in Aerospace Industry employment on NASA programs. Although Aerospace jobs will continue to decline in FY 1971, we expect employment to start increasing by the middle of FY 1972 with the end-of-year level being about equal to that at the beginning of the year.

In some areas we have had to again tighten our belts in FY 1972 in order to make it possible to proceed with the projects I have mentioned; we will further reduce the NASA Civil Service Work Force by 1,500 positions by the end of FY 1972. This represents a substantial reduction and brings the total NASA decrease in employment to 6,800 since July 1967.

We will decrease the amount of money spent on tracking and Data Acquisition; this will reduce the amount of data taken on some scientific missions.

We will make a substantial cutback in the advanced research and technology pointed at applications beyond 1980. In this regard we will limit the work on the Nerva Nuclear Rocket Engine to essential long-lead time items. This will preserve the capability to move forward with this highly efficient rocket development when the need arises, without requiring large expenditures of funds in FY 1972.

The NASA budget for FY 1972 is fiscally constrained. Nevertheless, I consider the program represented by this budget to be a good one: it allows the national to move forward in Aeronautics and in space. It meets the basic goals of our space program : the exploration of space, the increase of scientific knowledge and the practical applications of that knowledge to the benefit of life on earth" end of quote.

So, as you can judge from Dr. Low's remarks, all current rumors to the contrary, NASA is alive and well in 1971 and looking ahead to the 1970's as a decade of challenge in a mature and reasonable program.

Where now can Europe play a role in these efforts? What is possible? How can a contribution be implemented? Is Europe really interested? Is the U.S. really interested? All of these and more are the types of questions being asked today. Some have answers, some can only be the subject of speculation.

Let me begin first by saying most emphatically that both NASA and the U.S. government are very interested in International Cooperation and we do a lot of it, not just here in Europe, though are largest concentration has been traditionally here, but with all the space-interested countries around the world. In the past decade we have had successful International Space Projects involving 70 countries, 250 specific agreements, over 24 joint satellite projects whose over-all cost has been more than 400 million dollars, of which over 50% of this share being the contribution of the other Nations: we have also trained hundreds of Engineers, Technicians and Scientists of other countries in our Centres so I think our sincerity in maintaining and increasing Space Cooperation is well demonstrated. I want to make it doubly clear that our offer for European participation in Post-Apollo follows in the tradition of these past ten years and I am confident that we will find ourselves doing interesting and meaningful work together for as long as there is such work to do.

How can we do this in Post-Apollo? Well, I'm certain that most of you are aware that the European members of the Space Conference, under the present Chairmanship of Minister Lefebre of Belgium and our Government have been holding talks for the past several months and I believe that with these talks we have made progress in defining the basis for cooperative efforts in Post-Apollo. It is certainly premature to judge the outcome of these talks, since they are extremely complex in both political and technical terms, but nevertheless, we feel that progress is being made. More specifically while these talks have been going on, several studies and cooperative efforts are already under way. Both ESRO and ELDO have conducted studies on possible large multilateral undertakings of the Post-Apollo program such as a reusable tug, a Space Station Module, a Reusable Modular Station and Science and Technology Disciplines. There are European representatives taking part in several of NASA's committees, Steering Groups and Study Groups. Specifically in the area of interest to this colloquium is the participation of European representatives in the joint NASA/ESRO Joint Quarterly Study Review and Experiment Module Study Group. Also there are European representatives sitting in on NASA's Experiment Module Steering Committee and the Space Station Technology Advisory Council. There have been a number of visits of expert delegations representing multilateral organizations and individual countries, and finally, a number of specifically organized meetings and colloquiums such as this one today in which NASA participates in the hope that those interested in our efforts on these specific subjects will be better informed.

We believe that the Shuttle Transportation and the other elements of the Post-Apollo program system will truly revolutionize the use of space and that every possible effort must be made at this time to inform interested Nations, Organizations, Agencies, Universities and individuals as to the potential that will be at the disposal of man in the short time of a decade so that they may in their own judgement decide on a course of action.

Let me now go quickly through some slides to further explain what we have in mind and then we can use the remaining time for questions, keeping in mind that this afternoon and for the remainder of the Session my associates from NASA Headquarters will go into much greater detail in the specific areas of Space Medicine and Space Biology.

The following slides portray NASA's overall 1970s - 1980s space programme :

Figure 1

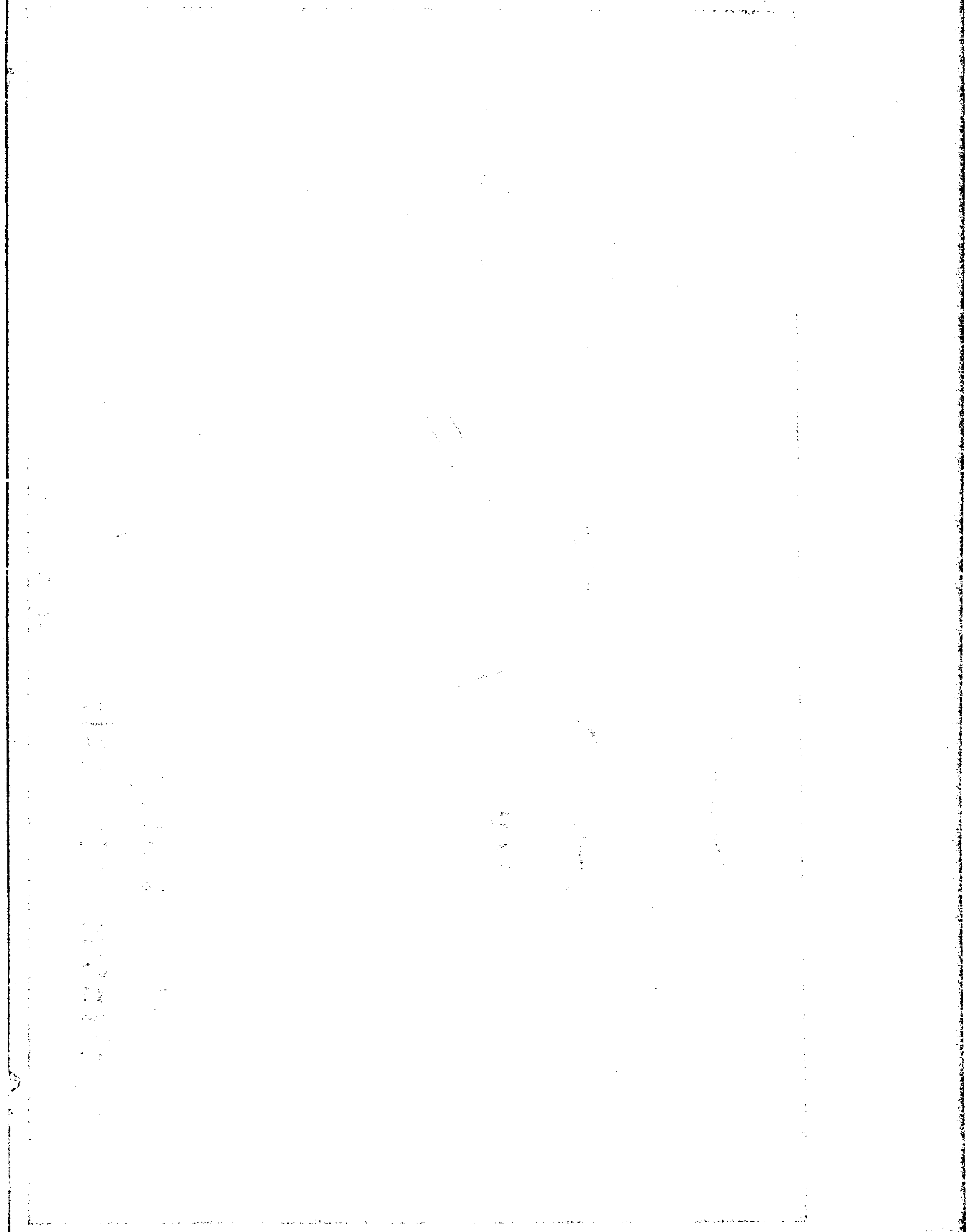

Figure 2

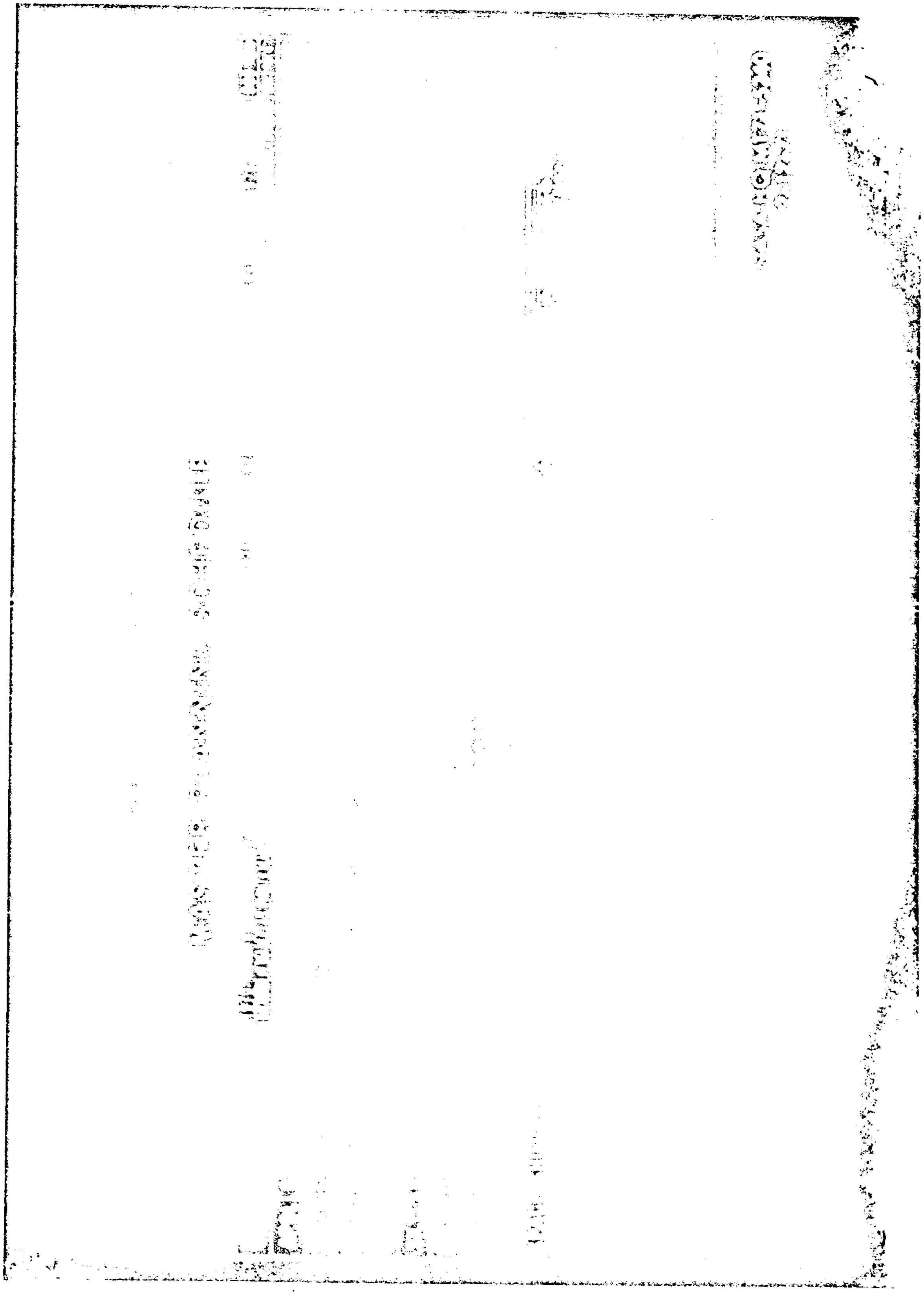

Figure 3

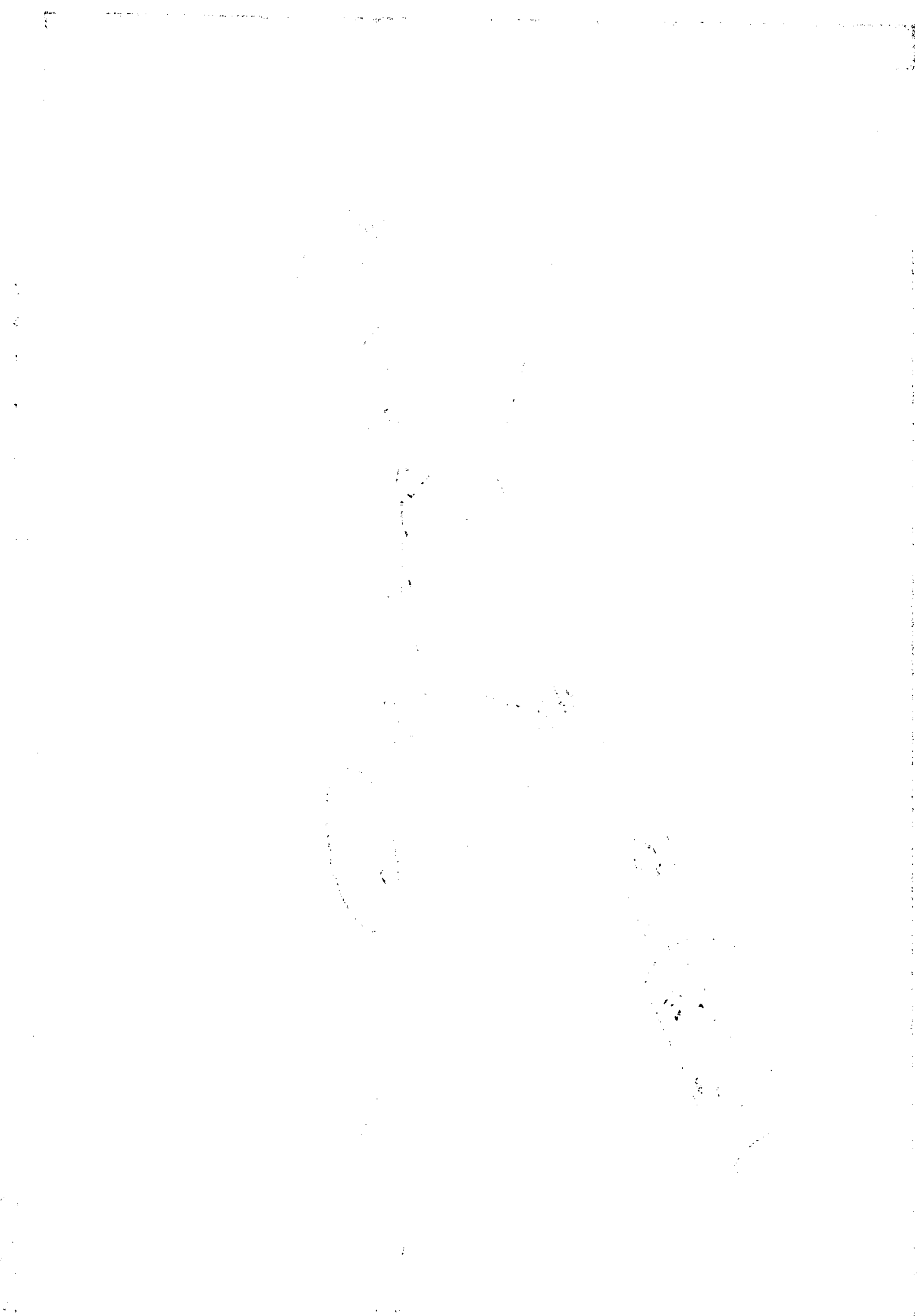

Figure 4

BASIC OBJECTIVES

- SCIENTIFIC INVESTIGATIONS IN EARTH ORBIT
- APPLICATIONS IN EARTH ORBIT
- LONG DURATION SPACE FLIGHTS OF MEN & SYSTEMS
- EFFECTIVE AND ECONOMICAL APPROACH TO THE DEVELOPMENT OF A BASIS FOR POTENTIAL FUTURE SPACE PROGRAMS

Figure 5

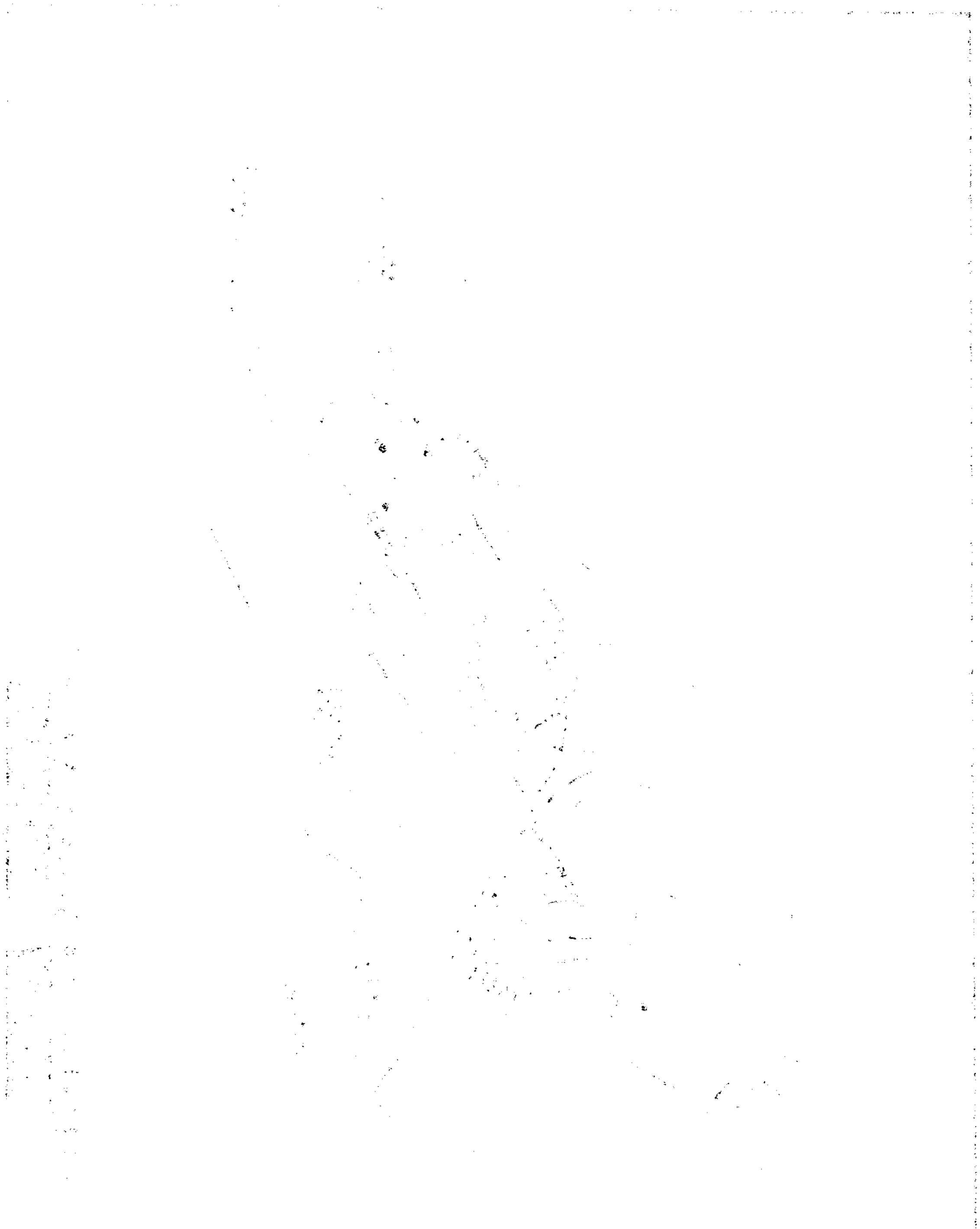

Figure 6

SKYLAB FLIGHT EXPERIMENTS

MEDICAL	M071/73	MINERAL BALANCE/BIOASSAY OF BODY FLUIDS
	M072	BONE DENSITOMETRY
	M074	SPECIMEN MASS MEASUREMENT
	M091	LBNP (PRE- & POST-FLIGHT)
	M092	INFLIGHT LOWER BODY NEGATIVE PRESSURE
	M093	VECTORCARDIOGRAM
	M111	CYTOGENETIC STUDIES OF BLOOD
	M112	MAN'S IMMUNITY - IN VITRO ASPECTS
	M113	BLOOD VOLUME & RED CELL LIFE SPAN
	M114	RED BLOOD CELL METABOLISM
	M131	HUMAN VESTIBULAR FUNCTION
	M133	SLEEP MONITORING
	M151	TIME & MOTION STUDY
	M171	METABOLIC ACTIVITY
	M172	BODY MASS MEASUREMENT
	T003	INFLIGHT AEROSOL ANALYSIS
	ESS	EXPERIMENT SUPPORT SYSTEM
OPERATIONS	M507	GRAVITY SUBSTITUTE WORKBENCH
	M508	EVA HARDWARE EVALUATION
	M509	ASTRONAUT MANEUVERING EQUIPMENT
	T013	CREW/VEHICLE DISTURBANCE
	T020	FOOT CONTROLLED MANEUVERING UNIT
	T029	PILOT DESCRIBING FUNCTION
SOLAR	S052	WHITE LIGHT CORONAGRAPH
	S054	X-RAY SPECTROGRAPHIC TELESCOPE
	S055	UV SPECTROMETERS
	S056	DUAL X-RAY TELECOPES
	S082	UV SPECTROGRAPH/HELIOGRAPH
TECHNOLOGY	T025	CORONAGRAPH CONTAMINATION MEASUREMENT
	T027	ATM CONTAMINATION MEASUREMENT
	D008	RADIATION IN SPACECRAFT
	D021	EXPANDABLE AIRLOCK TECHNOLOGY
	D024	THERMAL CONTROL COATINGS
	M415	THERMAL CONTROL COATINGS
	M479	ZERO GRAVITY FLAMMABILITY
	M512	MATERIALS PROCESSING IN SPACE
	T018	PRECISION OPTICAL TRACKING
OTHER SCIENCE	S009	NUCLEAR EMULSION
	S015	ZERO G SINGLE HUMAN CELLS
	S019	UV STELLAR ASTRONOMY
	S020	UV/X-RAY SOLAR PHOTOGRAPHY
	S061	POTATO RESPIRATION
	S063	UV AIRGLOW HORIZON PHOTOGRAPHY
	S071	CIRCADIAN RHYTHM - POCKET MICE
	S072	CIRCADIAN RHYTHM - VINEGAR FLY
	S073	GEGENSCHEIN/ZODIACAL LIGHT
	S149	PARTICLE COLLECTION
	S150	GALACTIC X-RAY MAPPING
	S183	ULTRAVIOLET PANORAMA
EREP	S190	MULTISPECTRAL PHOTOGRAPHIC FACILITY
	S191	TEN-BAND MULTISPECTRAL SCANNER
	S192	INFRARED SPECTROMETER
	S193	MICROWAVE SCATTEROMETER, ALTIMETER & RADIOMETER
	S194	L-BAND RADIOMETER

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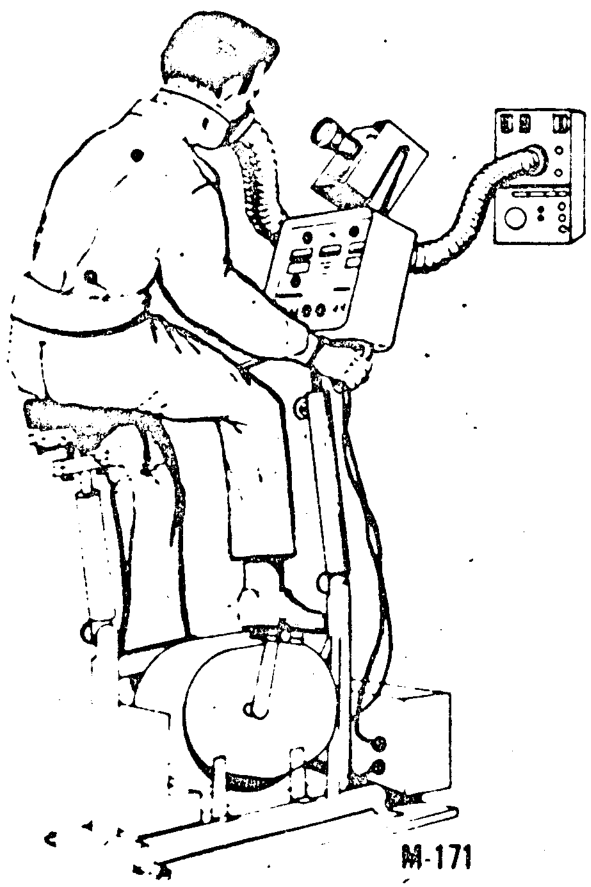
Figure 7

Figure 9

MEASURING BIOMEDICAL EFFECTS ON MAN



M-171

METABOLIC ACTIVITY

NUTRITIONAL FUNCTION

MUSCULOSKELETAL FUNCTION

CARDIOVASCULAR FUNCTION

[illegible]

[illegible]

NEUROPHYSIOLOGY

PULMONARY FUNCTION

METABOLISM

Figure 10

Figure 11

PROGRAM OBJECTIVES

- REDUCE COST OF DELIVERY TO SPACE
- REDUCE PAYLOAD COSTS
- SUPPORT BROAD PA[illegible]IONS
- INCREASE IN[illegible]PATION

Figure 12

SPACE SHUTTLE PLANNING SCHEDULE

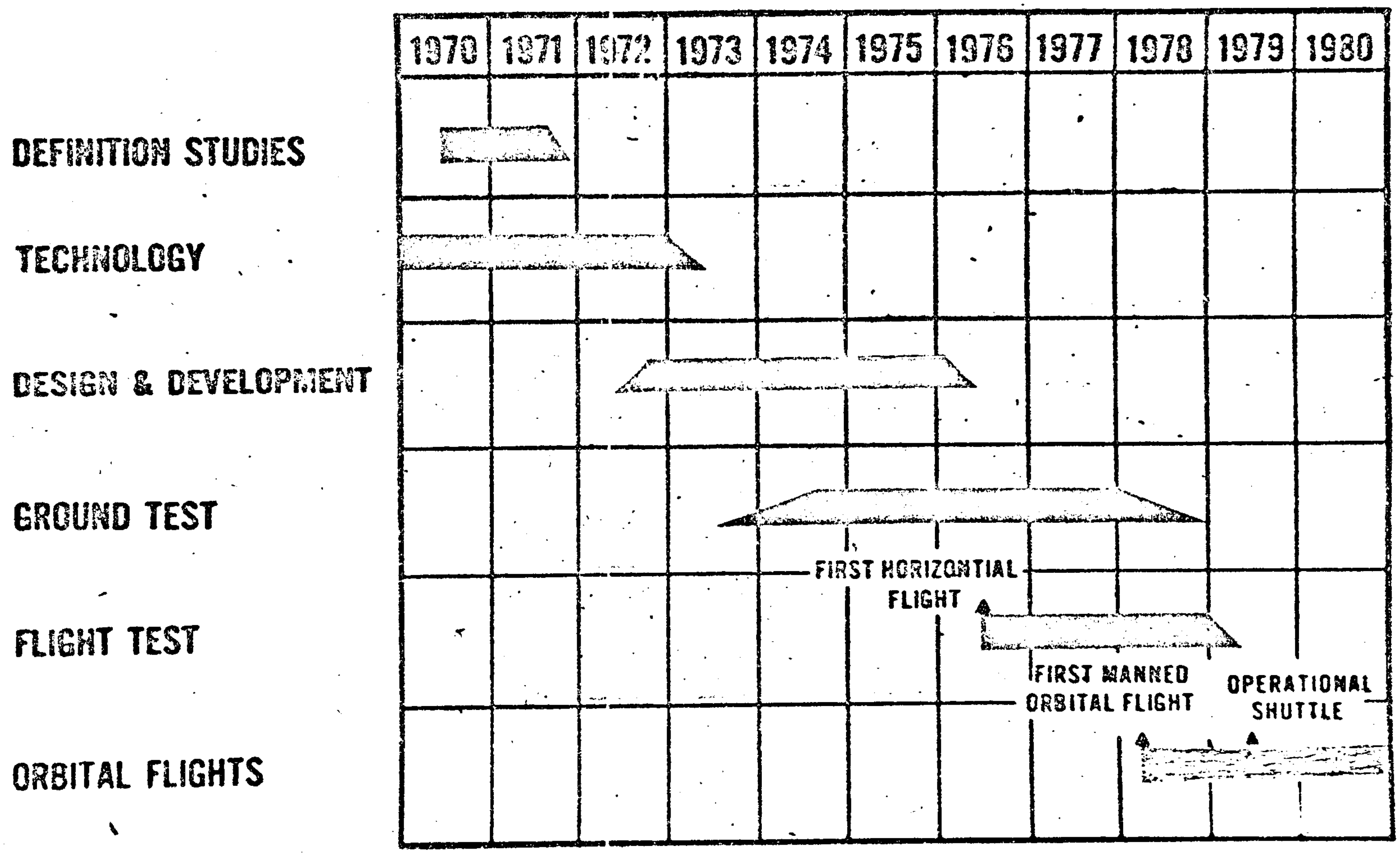


Figure 13

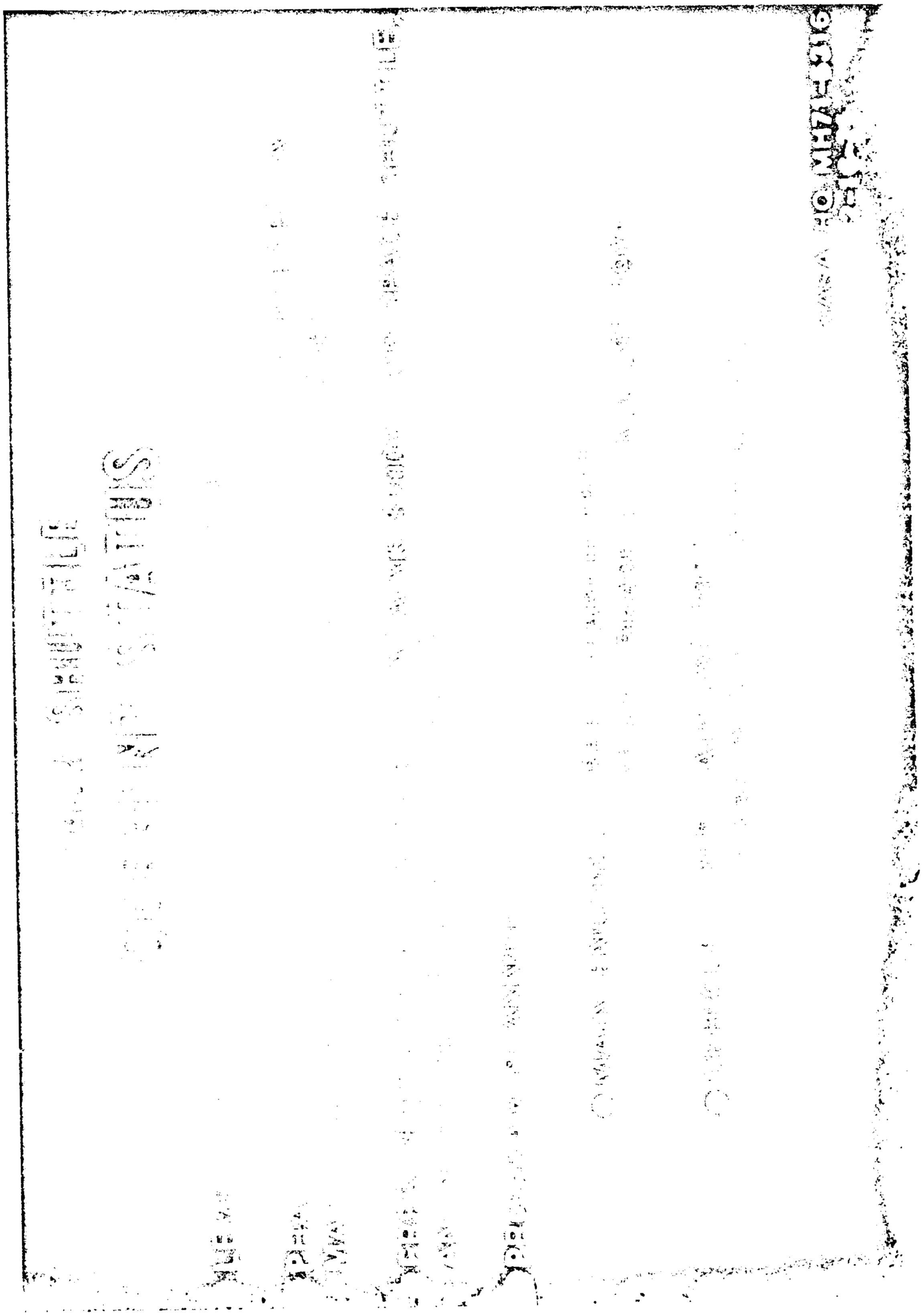


Figure 14

Figure 15

VEHICLE SYSTEMS CHARACTERISTICS

VERTICAL TAKE OFF/HORIZONTAL LAND...

TWO STAGE-FULLY REUSABLE

CREW OF ...

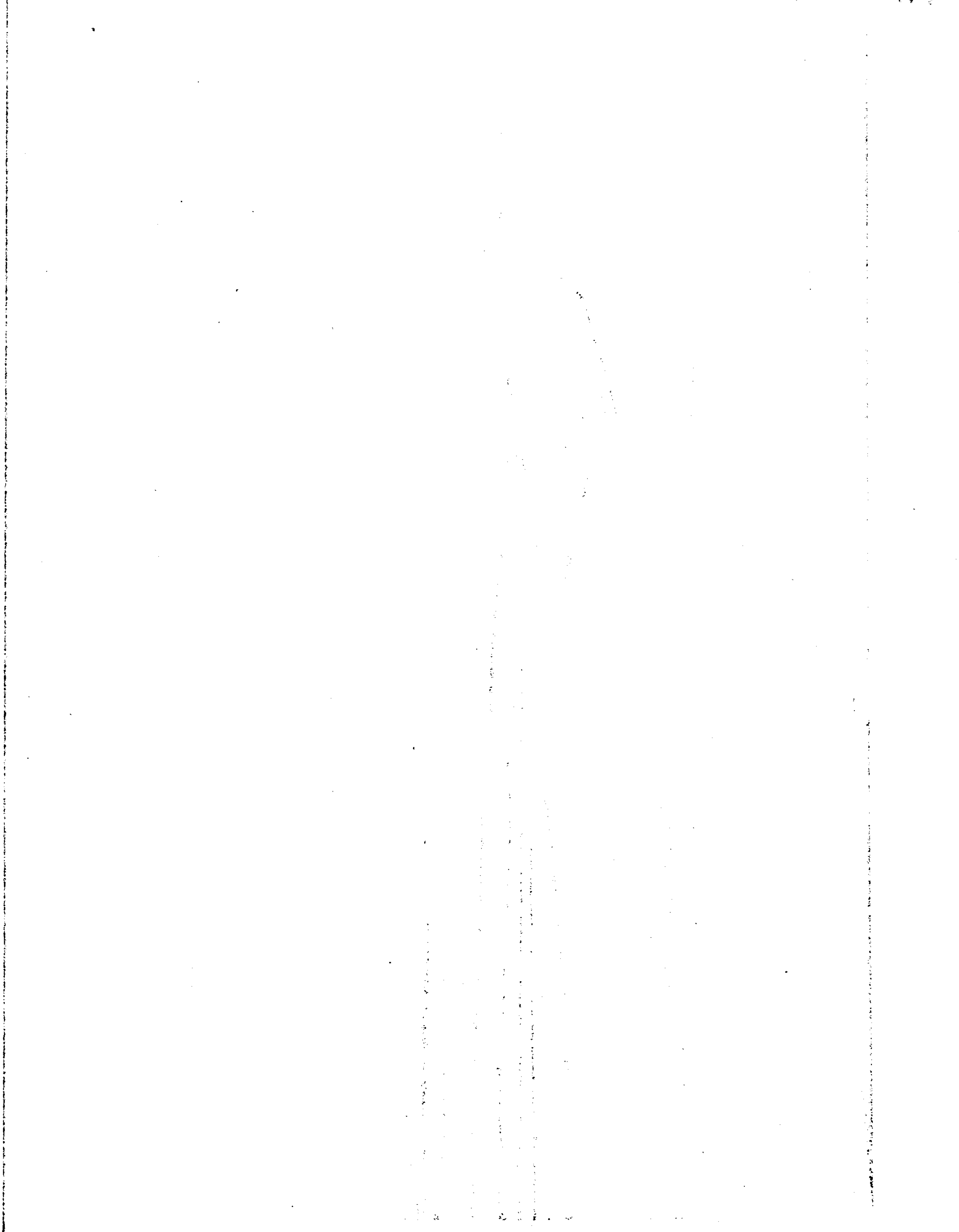
12 PASSENGERS

Figure 36

SPACE SHUTTLE ...

- SATELLITE PLACEMENT AND RETURN ... AND SERVICE SATELLITES
- ... 10 ...
- ... SCIENCE AND ...

Figure 17



[illegible]

EJECTION OF PAYLOADS

[illegible]

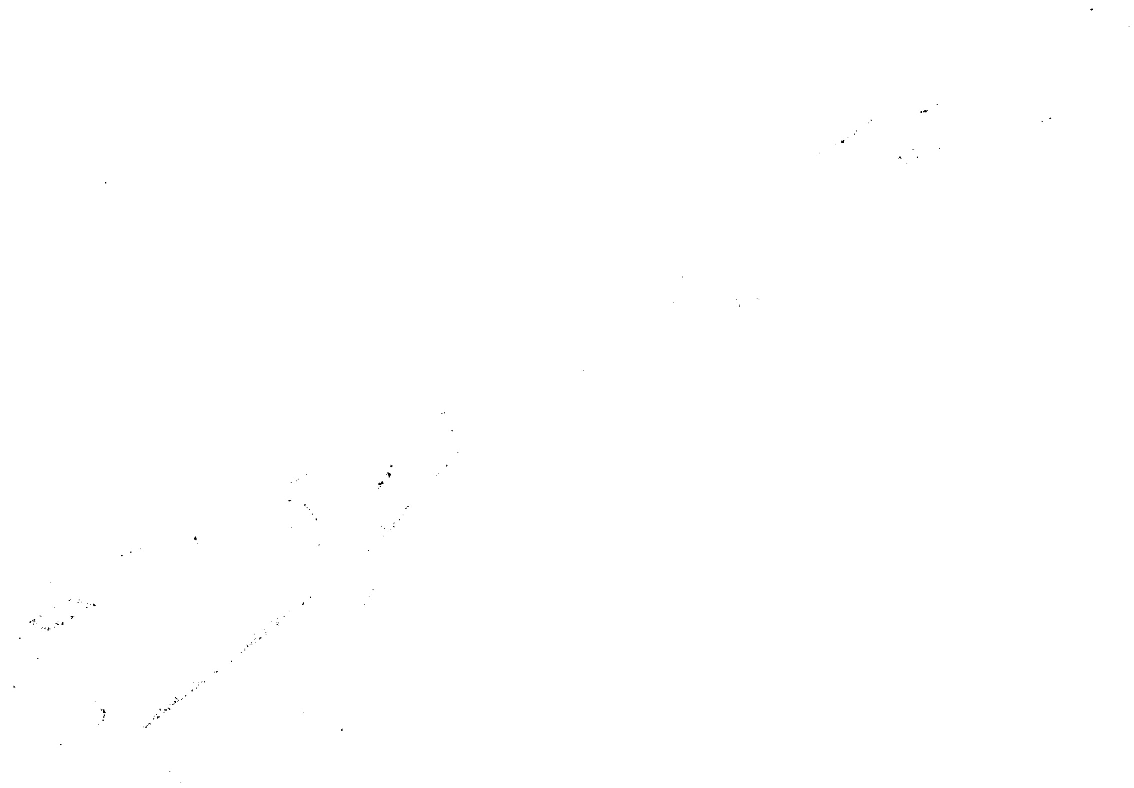


Figure 33

Figure 23

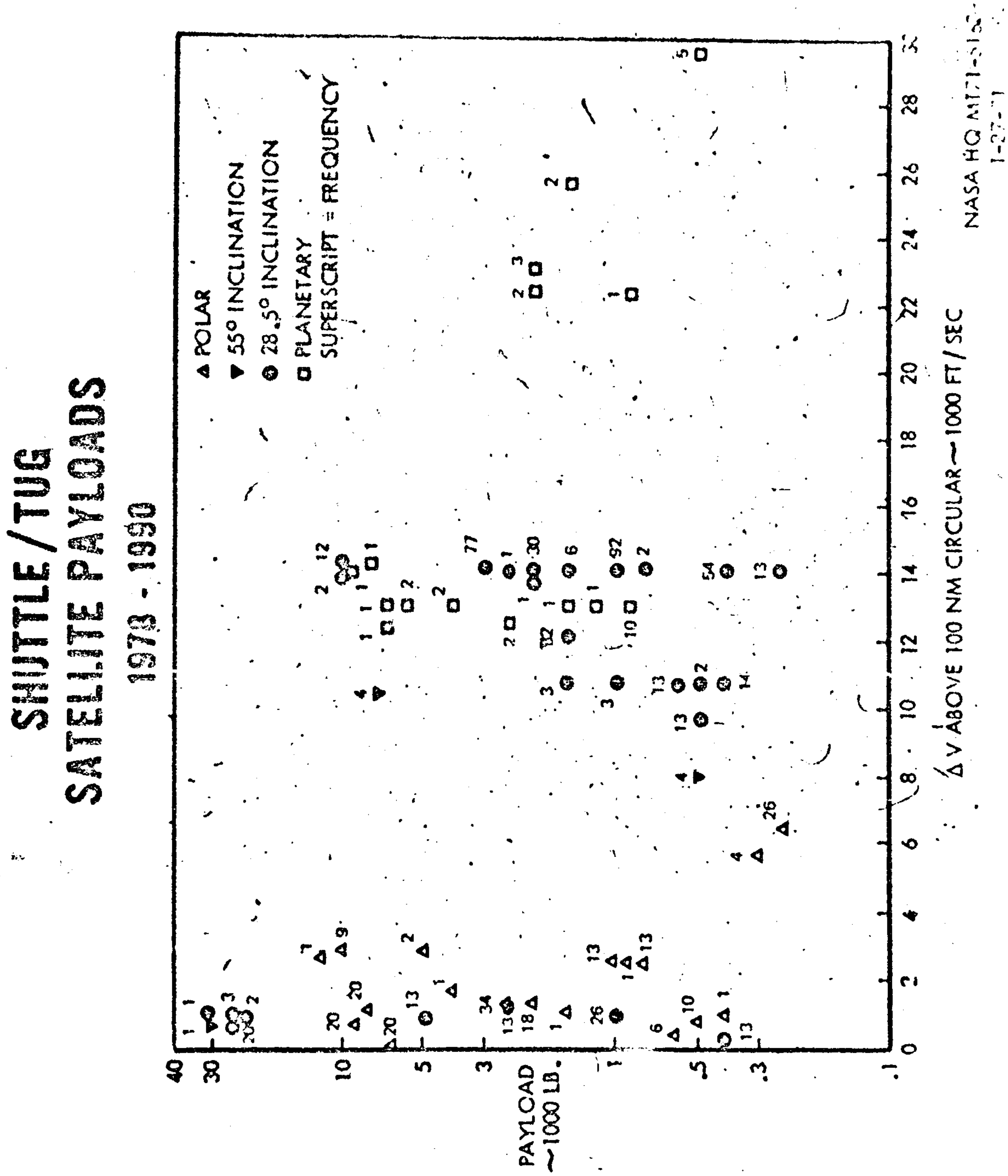

SHUTTLE/TUG
SATELLITE PAYLOADS
1978 - 1990
▲ POLAR
▼ 55° INCLINATION
⊙ 28.5° INCLINATION
□ PLANETARY
SUPERSCRIPT = FREQUENCY
PAYLOAD ~1000 LB.
ΔV ABOVE 100 NM CIRCULAR—1000 FT/SEC
NASA HQ

Figure 24

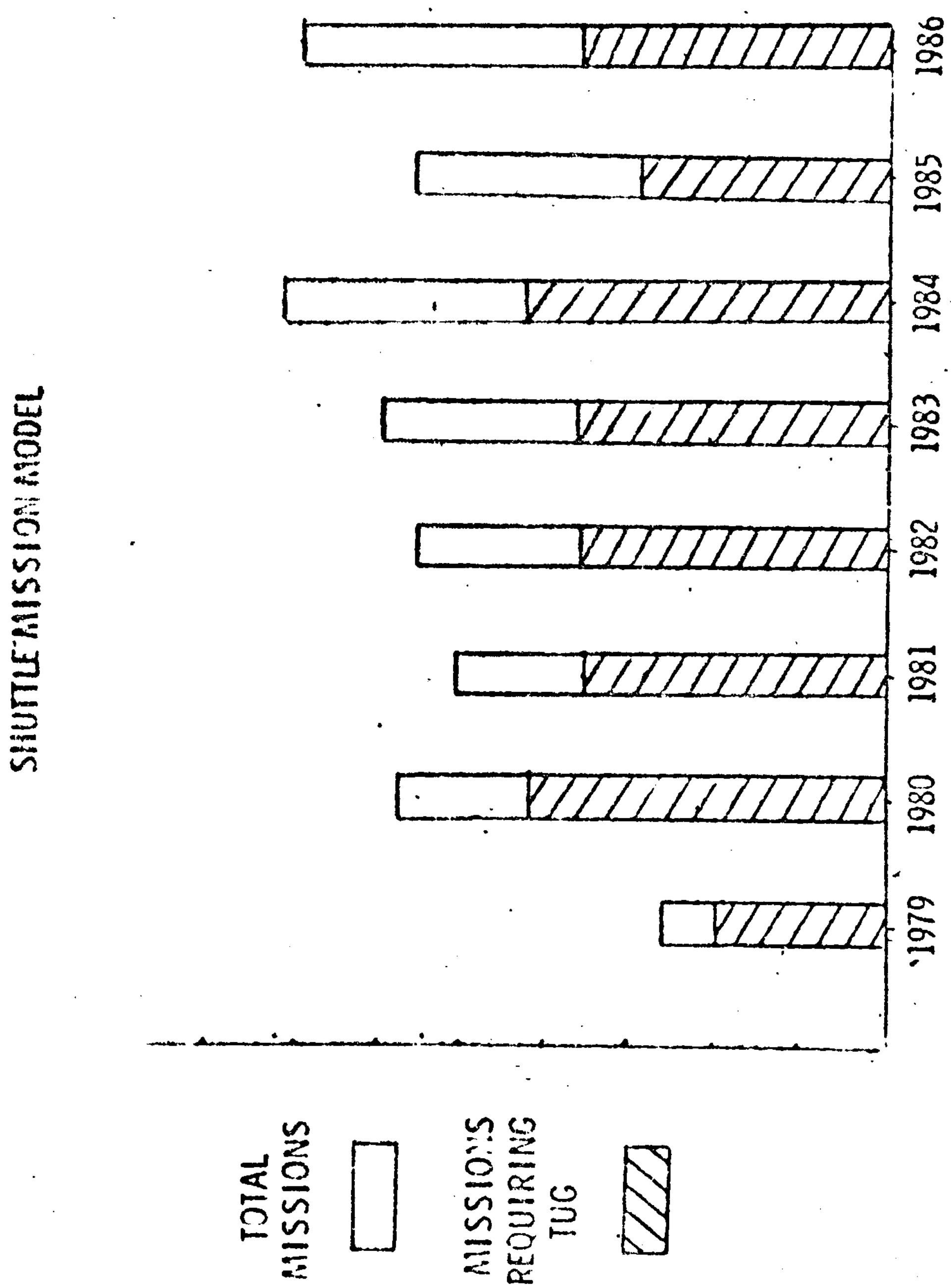
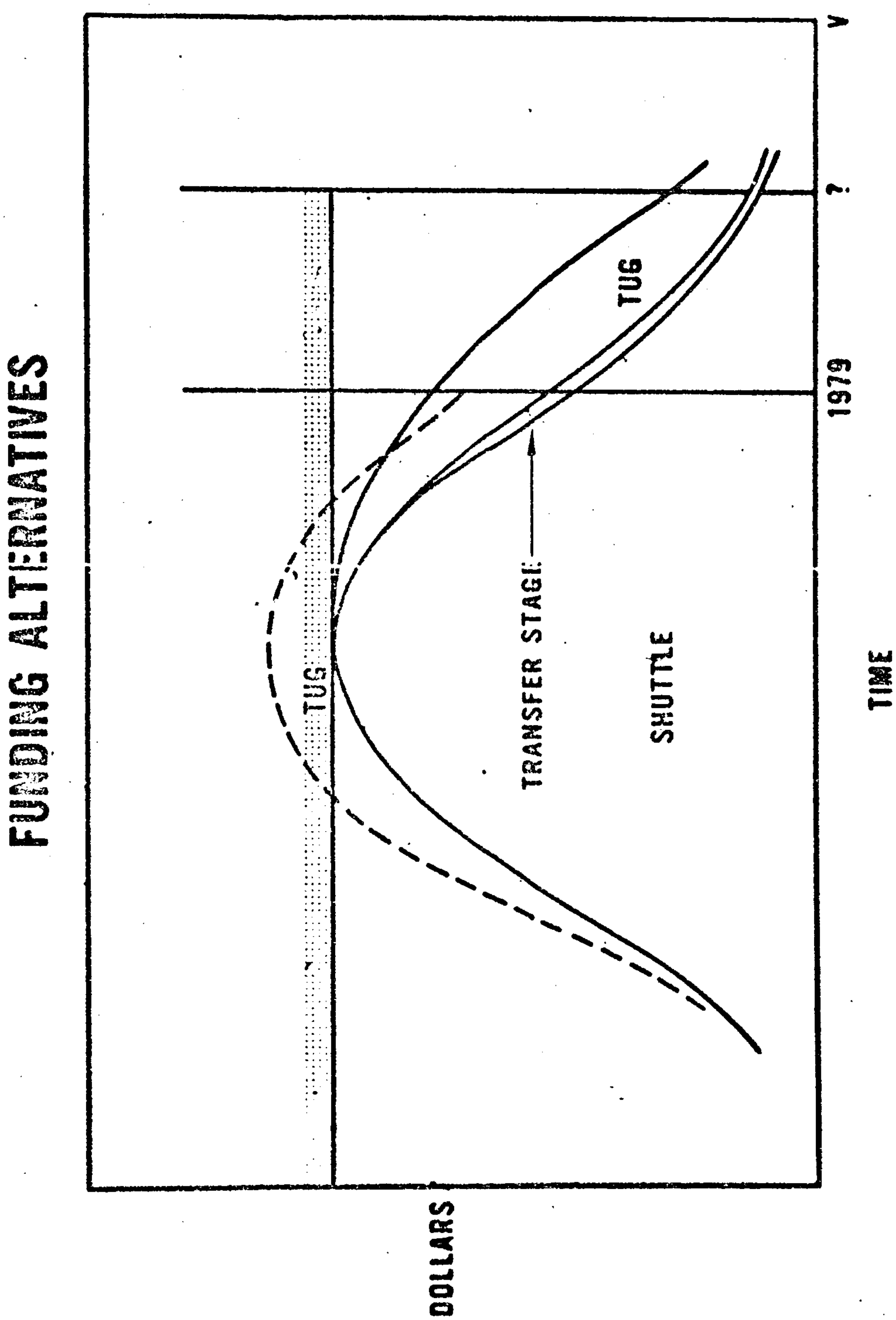

SHUTTLE MISSION MODEL
1979
1980
1981
1982
1983
1984
1985
1986
TOTAL MISSIONS
MISSIONS REQUIRING TUG

Figure 25


FUNDING ALTERNATIVES
DOLLARS
TIME
1979
?
TUG
TUG
TRANSFER STAGE
SHUTTLE

SUMMARY

SPACE TUG

- o A COMBINED SPACE SHUTTLE-SPACE TUG TRANSPORTATION SYSTEM IS NECESSARY TO PROVIDE PAYLOAD DELIVERY CAPABILITY BEYOND LOW EARTH ORBIT.
- o TO MEET U. S. PROGRAM OBJECTIVES, SPACE TUG CAPABILITY MUST BE AVAILABLE SHORTLY AFTER THE SPACE SHUTTLE BECOMES OPERATIONAL.
- o THE SPACE TUG WILL BE A SOPHISTICATED VEHICLE:
  - HIGH PERFORMANCE - STRUCTURAL EFFICIENCY, ENGINE SPECIFIC IMPULSE, SINGLE OR MULTI-STAGE.
  - ECONOMICS - VERSATILE IN APPLICATION; REUSABLE OR EXPENDABLE AS REQUIRED BY MISSION PARAMETERS.
  - COMPATIBLE WITH SPACE SHUTTLE.

NASA HQ MT71-5342
2-12-71

Figure 27

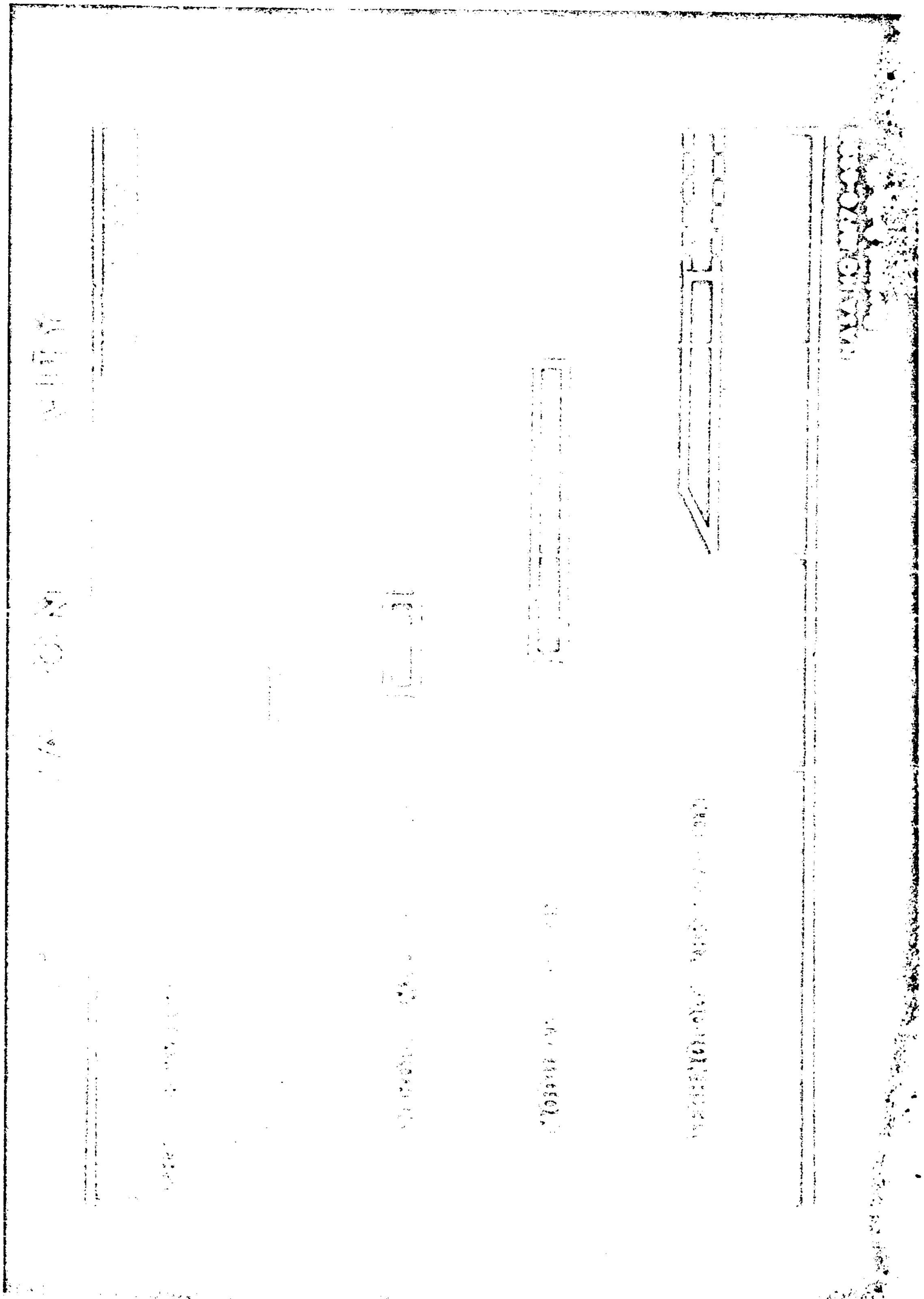


Figure 28

Figure 30

Figure 30

Figura 34

Figure 32

- [illegible]
- [illegible]
- [illegible]
  WITHOUT [illegible]
- SH[illegible] AND F[illegible]
  FLY[illegible] MODULES
- [illegible] REPLACEMENT AND
  [illegible]

Figure 33

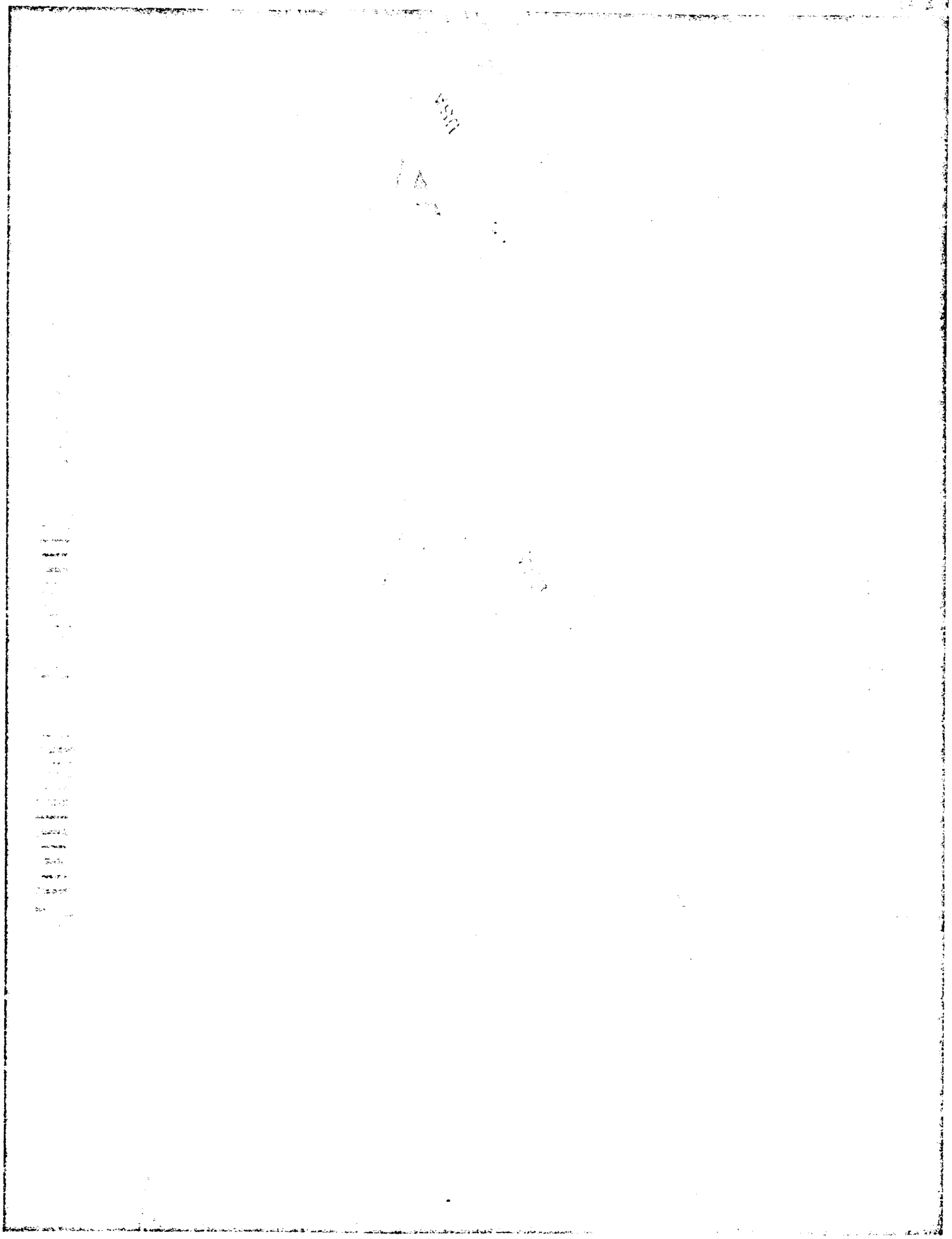


Figure [illegible]

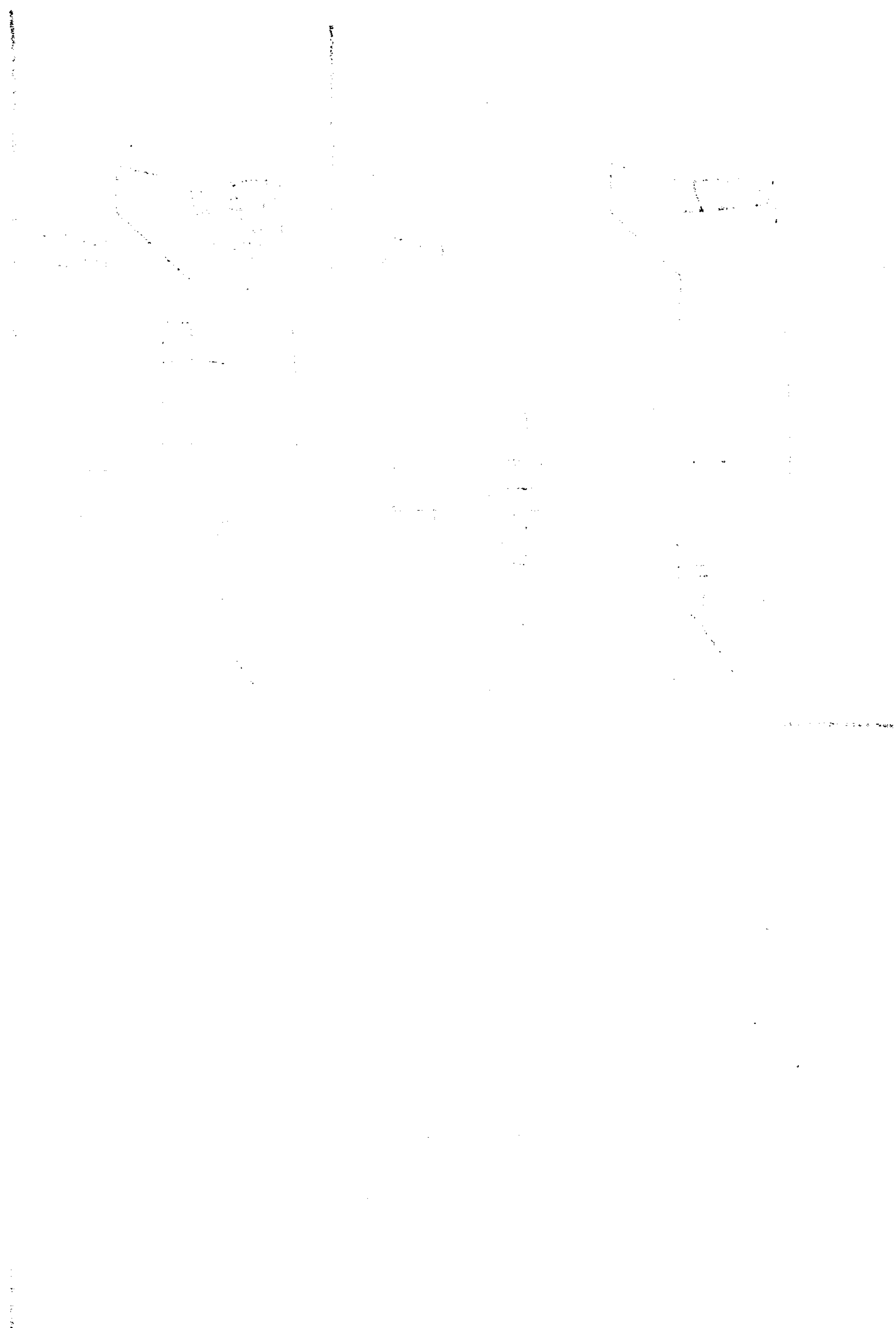


Figure 26

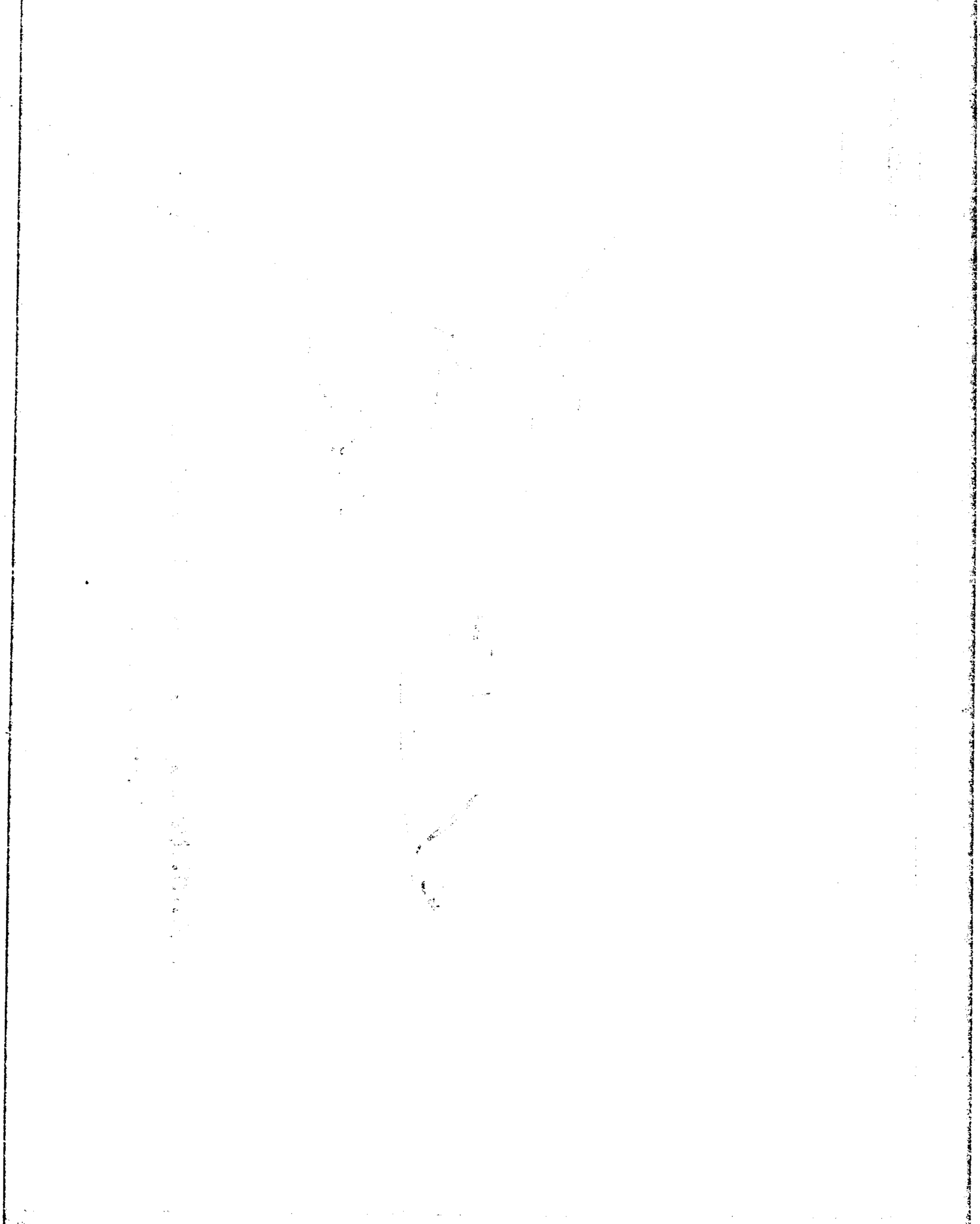


Figure 37

SPACE SHUTTLE - SHORT DURATION SCIENCE

AND APPLICATIONS [illegible] RESEARCH LABORATORY

Figure 39

SUMMARY

RESEARCH AND APPLICATIONS MODULES

(RAM)

- THE RAM'S ARE KEY ELEMENTS OF THE EARTH ORBITAL EXPERIMENT PROGRAM.
- PROVIDE VERSATILE AND ECONOMICAL LABORATORY AND OBSERVATION FACILITIES CAPABLE OF OPERATING IN AN ATTACHED OR FREE-FLYING MODE, SUPPORTING A VARIETY OF EXPERIMENT GROUPS.
- RAM'S CAN BE DEVELOPED AND USED ON A SCHEDULE INDEPENDENT FROM THE SPACE STATION.

NASA HQ MT71-5341
2-12-71

Figure 40

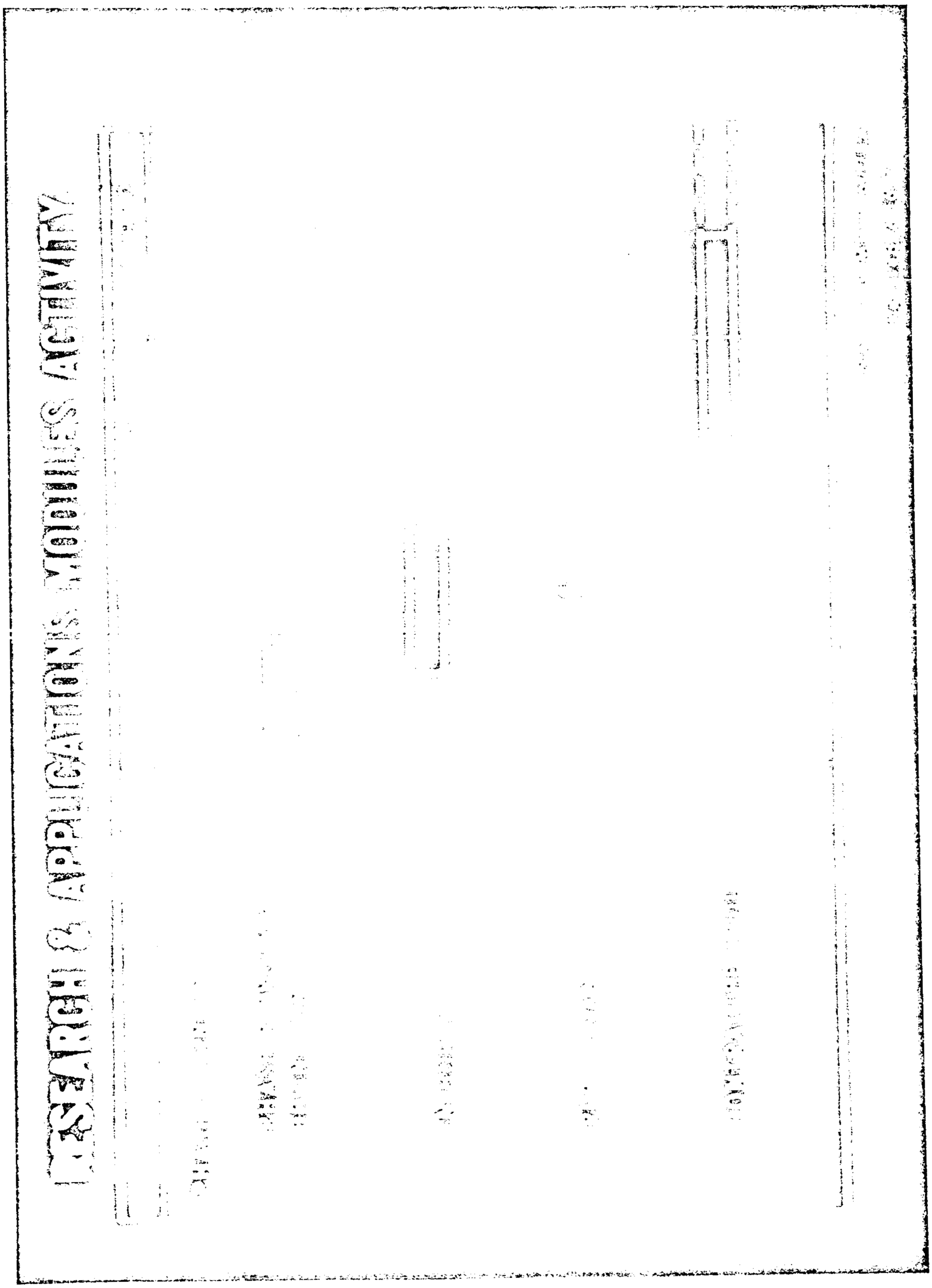


Figure 41

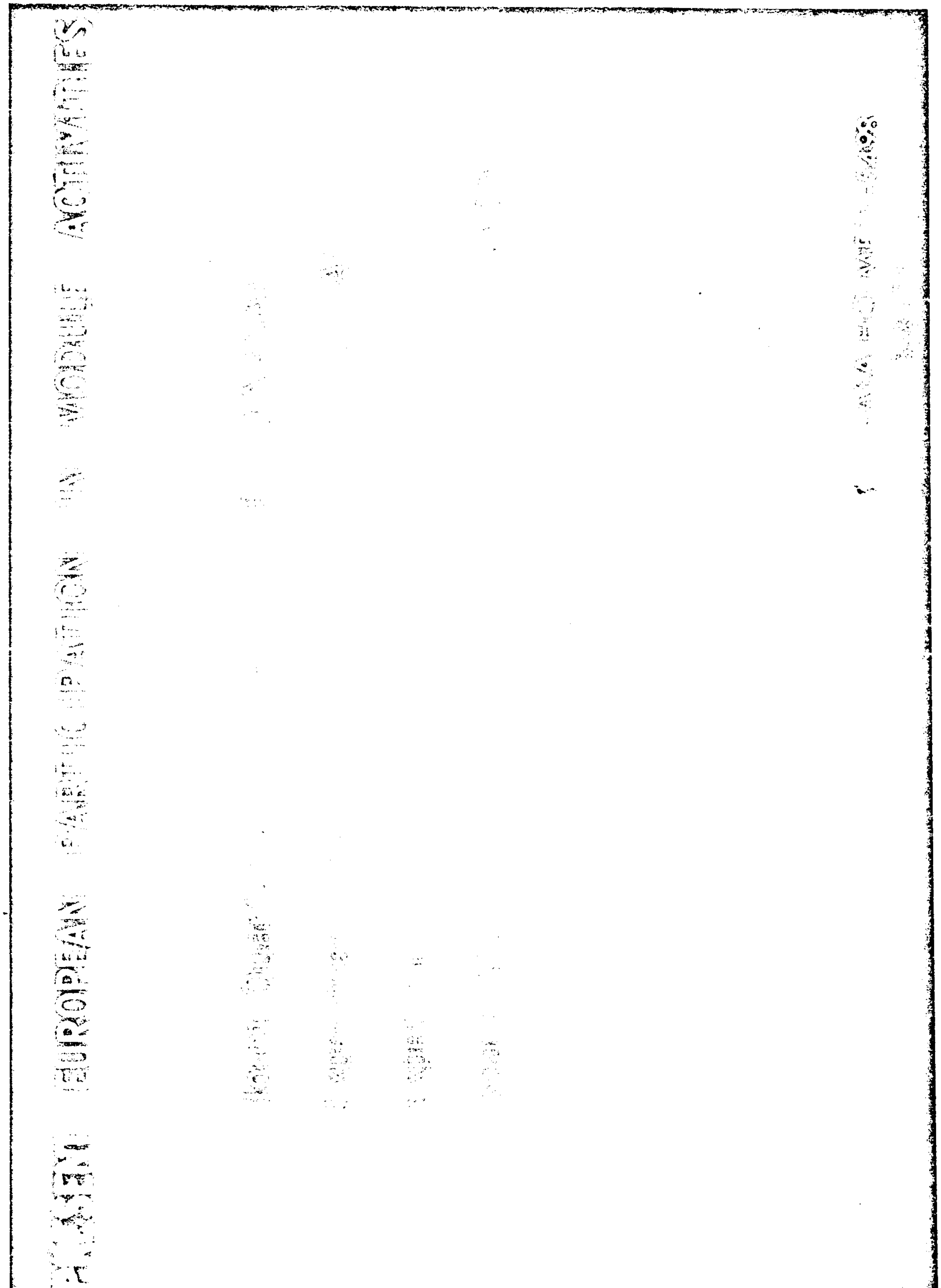


Figure 42